

What is claimed is:

1. An optical data decoder for detecting a data sequence from an optical
2 signal carrying data signals at different light wavelengths and a marker wavelength signal
multiplexed as a single signal, the data sequence being encoded on the different light
4 wavelengths by modifying selected data signals, the optical data decoder comprising:
a plurality of optical detector units each corresponding to each different light
6 wavelength carrying a data signal, the optical detector units each having:
a photo detector having an anode and a cathode, the photo detector in
8 exposure to the data signal; and
a reference detector having an anode, a cathode, the anode of the reference
10 detector being coupled to the cathode of the photo detector, and the cathode of the
reference detector being coupled to the anode of the photo detector, the reference
12 detector in exposure to the marker wavelength signal.
2. The optical data detector of claim 1 further comprising:
2 a wavelength filter which filters light at a wavelength corresponding to the data
signal to the photo detector; and
4 a reference wavelength filter which filters light at the marker wavelength signal to
the reference detector.

3. The optical data detector of claim 1 further comprising a spectrometer in
2 exposure to the optical signal and filters the optical signal to output a light signal
modulated at a certain wavelength, the output light signal being coupled to one of the
4 optical detector units.

4. The optical data detector of claim 1 wherein the data sequence further
2 includes a series of one and zero bits, the one bits being coded by attenuating the light of
the data signals at selected wavelengths and the zero bits being coded by maintaining the
4 data signals at their original light level.

5. The optical data detector of claim 1 wherein the photo detector is coupled
2 to a first reverse bias element and the reference detector is coupled to a second reverse
bias element.

6. The optical data detector of claim 1 wherein the data sequence further
2 includes a series of one and zero bits, the one bits being coded by amplifying the light of
the data signals at selected wavelengths and the zero bits being coded by maintaining the
4 data signals at their original light level.

7. The optical data detector of claim 6 wherein each detector unit has an
2 input terminal corresponding to the cathode of the photo detector and an output terminal

corresponding to the anode of the reference detector and each detector unit is coupled in
series to each other via the input and output terminals.

8. The optical data detector of claim 7 wherein selected detector units are set
to decode a one bit, the selected detector units further comprising:

a reference light source exposed to the reference detector;

an aperture mask interposed between the reference detector and the marker
wavelength signal which decreases the light output to the reference detector in response
to light at the selected wavelength;

wherein the aperture mask is sized and the light output level of the reference light
source are selected such that the voltage across the output terminal is zero when the light
signal at the selected wavelength indicating a one bit and a reference signal at the marker
wavelength are exposed to the detector unit.

9. The optical data detector of claim 8 wherein the photo detector is a NiP
photodiode and the reference detector is a PiN photodiode.

10. The optical data detector of claim 9 wherein the photo detector and the
reference detector are avalanche photodiodes.

11. The optical data detector of claim 6 wherein selected detector units are set
2 to decode a zero bit, the selected detector units further comprising:
a detector light source exposed to the photo detector; and
4 wherein the light output level of the detector light source is selected such that the
voltage across the output terminal is zero when the light signal at the selected wavelength
6 indicating a zero bit and a reference signal at the reference wavelength are exposed to the
detector unit.

12. The optical data detector of claim 11 wherein the photo detector is a PiN
2 photodiode and the reference detector is a NiP photodiode.

13. The optical data detector of claim 1 wherein the photo detector and
2 reference detector are avalanche photodiodes.

14. The optical data detector of claim 7 further comprising:
2 an output terminal which is coupled in series to the detector unit last in the series
of detector units;
4 a processor coupled to the output terminal, the processor determining whether a
low voltage signal is present signifying that the encoded data sequence matches a
6 selected data sequence.

15. The optical data detector of claim 6 wherein:

2 the detector units further comprise:

a reference light source exposed to the reference detector;

4 an aperture mask interposed between the reference detector and the marker
wavelength signal which decreases the light output to the reference detector in response
6 to light at the selected wavelength;

wherein the photo detector is a NiP photodiode and the reference detector is a PiN
8 photodiode, and the aperture mask is sized and the light output level of the reference light
source are selected such that the voltage across the output terminal is zero when the light
10 signal at the selected wavelength indicates a one bit and a reference signal at the marker
wavelength are exposed to the detector unit; and such that the voltage across the output
12 terminal is at a set level when the light signal at the selected wavelength indicates a one
bit;

14 wherein the one bit detectors are wired in series and the zero bit detectors are
wired in series; and

16 a processor coupled to the output terminal, the processor determining whether a
low voltage signal is output from all of the one bit detectors and a selected voltage level
18 is output from the zero bit detectors signifying that the encoded data sequence matches
the selected data sequence of the optical data detector.

16. The optical data detector of claim 1 wherein the optical data is an address
2 code relating to a selected data signal.

17. The optical data detector of claim 1 wherein the optical data is a control
2 code relating to a selected data signal.

18. The optical data detector of claim 1 wherein the photo detector and the
2 reference detector are integrated circuits fabricated from group IV elements.

19. The optical data detector of claim 1 wherein the photo detector and the
2 reference detector are integrated circuits fabricated from group III-V elements.

20. A method for transmitting a data sequence in an optical data transmission
2 system having multiple data signals modulated on different selected light wavelengths,
the multiple data signals being multiplexed into a single optical signal; the method
4 comprising the steps of:

providing a marker signal modulated on a selected reference wavelength; and
6 modifying selected data signals to encode the data sequence to correspond to a
single selected data signal.

21. The method of claim 20 wherein the data sequence is an address code
2 relating to the single selected data signal.

22. The method of claim 20 wherein the data sequence is a control code.

23. The method of claim 20 further comprising the steps of:

2 determining whether a marker signal is present;

optically detecting the signals at each selected light wavelength; and

4 determining whether the data sequence matches a selected data sequence.

24. The method of claim 23 wherein the data sequence is a series of bits

2 having a one or zero value, each bit corresponding to a selected light wavelength and

wherein the amplitude of each selected light wavelength signal representing a one bit

4 is amplified.

25. The method of claim 24 further comprising the steps of:

2 determining whether a one is encoded at a selected wavelength by

measuring the light level at that selected wavelength;

4 emitting additional light to adjust the light level at that selected

wavelength;

6 attenuating the marker signal;

measuring the light level of the attenuated marker signal at the reference

8 wavelength;

determining that a one is encoded when the adjusted light level at the

10 selected wavelength and the attenuated marker signal are identical.

26. The method of claim 24 further comprising the steps of:

2 determining whether a zero is encoded at a selected wavelength by

measuring the light level at that selected wavelength;

4 emitting additional light to adjust the light level at that selected

wavelength;

6 measuring the light level of the marker signal at the reference wavelength;

determining that a zero is encoded when the adjusted light level at the selected

8 wavelength and the attenuated marker signal are identical.

27. The method of claim 20 wherein the data sequence is a series of bits

2 having a one or zero value, each bit corresponding to a selected light wavelength and

wherein the amplitude of each selected light wavelength signal representing a one bit is

4 attenuated.

28. The method of claim 20 wherein the data sequence is a series of bits
2 having a one or zero value, each bit corresponding to a selected light wavelength and
wherein the amplitude of each selected light wavelength signal representing a one bit
4 is amplified and wherein the method further comprises the steps of:
establishing a comparison data sequence having a series of bits having a one or
6 zero value corresponding to each bit of the data sequence;
determining whether a one or a zero is encoded at a selected wavelength by
8 measuring the light level at that selected wavelength;
emitting additional light to adjust the light level at that selected
10 wavelength;
attenuating the marker signal;
12 measuring the light level of the attenuated marker signal at the reference
wavelength;
14 comparing the adjusted light level at the selected wavelength and the
attenuated marker signal;
16 producing a zero output voltage when a one bit is encoded on the selected
wavelength and producing a selected output voltage when a zero bit is encoded on the
18 selected wavelength; and
determining whether the data sequence is identical to the comparison data
20 sequence by:

adding the values for all the output voltages of the wavelengths which
22 correspond to one bits of the comparison data sequence;

adding the values for all the output voltages of the wavelengths which
24 correspond to zero bits of the comparison data sequence; and

indicating a data sequence match when the added values of the one bit
26 wavelengths equal zero and the added values of the zero bit wavelengths equal a selected
total output voltage.

29. The method of claim 23 further comprising the steps of:

2 providing an optical data signal representative of digital data;

modulating the data signal at a selected optical wavelength;

4 demultiplexing the multiple data signals;

providing a data sequence for the data signal on selected multiple data signals;

6 and

multiplexing the multiple data signals and the data signals into a single optical

8 signal.

30. The method of claim 23 further comprising the steps of:

2 determining the traffic patterns of optical signals in an optical fiber network based
on the data sequence;

4 determining an optimal routing path of the optical signal; and

routing the optical signal to the optimal routing path.

31. An optical router for routing data signals from an optical fiber to a
2 selected destination, the optical fiber carrying a single optical signal which has
multiplexed data signals modulated at different light wavelengths, a marker wavelength
4 signal, and a data sequence corresponding to a selected data signal encoded on the
different light wavelengths of the data signals, the router comprising:
6 an optical buffer having:
an optical data detector coupled to the optical fiber, the optical data
8 detector having detector units each sense light at a different wavelength and sense the
marker wavelength signal, the detector producing an output indicative of the presence of
10 a selected data sequence in the data sequence;
a fiber optic delay loop which holds the optical signal;
12 a data output channel;
an optical switch which is coupled to the optical fiber and the data channel;
14 wherein the fiber optic delay loop has a length sufficient to delay the optical signal for a
time interval sufficient to detect the selected data code and activate the optical switch;
16 and
a processor unit coupled to the buffer and the optical switch, wherein the
18 processor unit reads the output of the detector of the buffer and controls the optical

switch to divert the light signal to the data channel on detection of the selected data
20 sequence.

32. The optical router of claim 31 wherein the data channel is a fiber optic
2 cable.

33. The optical router of claim 31 further comprising an optical to electrical
2 converter coupled to the optical switch and the data output channel, the converter
converting the light signal to an electrical signal.

34. The optical router of claim 31 further comprising a demultiplexer coupled
2 to the buffer which separates the multiplexed data signals into separate light signals
modulated at different wavelengths.

35. The optical router of claim 34 further comprising:
2 a data input channel providing digital data as a new light signal;
wherein the optical switch is coupled to the demultiplexer and data input, the
4 optical switch modulating the new light signal at a selected wavelength;
a multiplexer coupled to the optical switch which combines the data signals, the
6 new light signal and the marker wavelength signal into a single optical signal.

36. The optical router of claim 31 wherein the optical switch is a switch
2 fabric.

37. The optical router of claim 31 wherein the optical switch is an electrically
2 controlled micro mirror.

38. The optical router of claim 31 wherein the optical detector units each
2 have:

a photo detector having an anode and a cathode, the photo detector in
4 exposure to the single signal;

a wavelength filter which filters light at a wavelength corresponding to a
6 data signal to the photo detector;

a reference detector having an anode, a cathode, the anode of the reference
8 detector being coupled to the cathode of the photo detector, and cathode of the
reference detector being coupled to the anode of the photo detector;

10 a reference wavelength filter which filters light at the marker wavelength
signal to the reference detector.

39. The optical router of claim 38 wherein the photo detector is coupled to a
2 first reverse bias element and the reference detector is coupled to a second reverse bias
element.

40. The optical router of claim 38 wherein the additional data further includes
2 a series of one and zero bits, the one bits being coded by attenuating the light of the data
signals at selected wavelengths and the zero bits being coded by maintaining the data
4 signals at their original light level.

41. The optical router of claim 31 wherein the additional data further includes
2 a series of one and zero bits, the one bits being coded by amplifying the light of the data
signals at selected wavelengths and the zero bits being coded by maintaining the data
4 signals at their original light level.

42. An optical code detector for detecting an information code from an optical
2 signal carried on an optic fiber, the optical signal having a header portion containing the
information code encoded with different levels of light and a data portion, the optical
4 code decoder comprising:

a plurality of optical storage devices coupled to the optical fiber, each of which
6 stores a segment of the information code and emitting the light encoding the segment;

an optical detector unit for each segment of the information code, each of the
8 optical detector units being exposed to the segment light and each having:

a first photo detector having an anode and a cathode;

10 a second photo detector having an anode, a cathode, the anode of the
 second photo detector being coupled to the cathode of the first photo detector, and
12 the cathode of the second photo detector being coupled to the anode of the first
 photo detector; and
14 a light emitter array optically coupled to the optical detector units.

 43. The optical code detector of claim 42 wherein the first photo detector is
2 coupled to a first reverse bias element and the second photo detector is coupled to a
 second reverse bias element.

 44. The optical code detector of claim 42 wherein the information code
2 further includes a series of one and zero bits, the one bits being coded by an amplified
 light signal and the zero bits being coded by maintaining the light signal at a low level.

 45. The optical code detector of claim 42 wherein each detector unit has an
2 input terminal corresponding to the cathode of the first photo detector and an output
 terminal corresponding to the anode of the second photo detector and each detector unit
4 is coupled in series to each other via the input and output terminals.

 46. The optical code detector of claim 42 wherein the photo detectors are
2 integrated circuits fabricated from group IV elements.

47. The optical code detector of claim 42 wherein the photo detectors are
2 integrated circuits fabricated from group III-V elements.

48. The optical code detector of claim 44 wherein the optical storage devices
2 further include:

a plurality of fiber optic conversion loops, each loop corresponding to a bit of the
4 information code;

a tap fiber; and

6 an optical amplifier having an input coupled to the tap fiber and an output coupled
to the first photo detector.

49. The optical code detector of claim 48 wherein the presence of a matching
2 information code is indicated by a zero voltage output from the detector units.

50. The optical data detector of claim 48 wherein the light emitter array has a
2 plurality of light sources, each light source being coupled to the second photo detector,
the light sources emitting a pattern of light indicative of a selected code with a high light
4 level representing a one bit in the code and a low light level representing a zero bit in the
code;

6 wherein the detector units detect either a one bit or a zero bit,

the first photo detector of the one bit detector units being a NiP photodiode
8 coupled to the output of the optical amplifier and the second photo detector of the one bit
detector units being a PiN photodiode; and

10 the first photo detector of the zero bit detector units being a PiN photodiode
coupled to the output of the optical amplifier and the second photo detector of the one bit
12 detector units being a NiP photodiode.

51. The optical data detector of claim 48 wherein the light emitter array is a
2 pattern generator having a memory storing the possible iterations of the information data
and generates an output signal representing a one bit or a zero bit for each bit of each of
4 the iterations of the information data.

52. The optical data detector of claim 51 wherein the first photo detector is a
2 NiP photo detector and the second photo detector is a PiN photo detector, and the
detector further comprises:

4 a first switch fabric for each detector unit having an input coupled to the output of
the optical amplifier, an optical conduit coupled to the first photo detector and a second
6 optical conduit coupled to the second photo detector;
a laser source;

8 a second switch fabric for each detector unit having an input coupled to the output
signal of the pattern generator and the laser source, an optical conduit coupled to the
10 second photo detector and a first optical conduit coupled to the first photo detector; and
wherein the first and second switch fabrics divert the output of the laser source to
12 the first photo detector and the output of the storage device to the second photo detector
when the output signal represents a zero bit; and
14 wherein the first and second switch fabrics divert the output of the laser source to
the second photo detector and the output of the storage device to the first photo detector
16 when the output signal represents a one bit.

53. The optical code detector of claim 52 wherein the storage devices further
2 comprise an optical latch coupled to the output of the optical amplifier, the optical latch
having a first set of semiconductor optical amplifiers coupled to the output of the optical
4 amplifier and an output;

 a second set of semiconductor optical amplifiers having an input coupled to the
6 laser source and an input coupled to the output of the first set of semiconductor optical
amplifiers; and

8 wherein when the input to the optical amplifier is a high signal, the output of the
light source is output from the second set of semiconductor optical amplifiers and when
10 the input to the optical amplifier is a low signal, a low signal is output from the second
set of semiconductor optical amplifiers.

54. The optical code detector of claim 53 further comprising a reset line
2 coupled to the input of the first set of semiconductor optical amplifiers, wherein a high
signal on the reset lines prevents the input from the optical amplifier.

55. The optical code detector of claim 42 wherein the header portion has a
2 second information code and the detector further comprising:

an optical detector unit for each segment of the second information code, each of
4 the optical detector units being exposed to the segment light and each having:

a first photo detector having an anode and a cathode;

6 a second photo detector having an anode, a cathode, the anode of the first
photo detector being coupled to the cathode of the second photo detector, and the
8 cathode of the first photo detector being coupled to the anode of the second photo
detector; and

10 a light emitter array optically coupled to the optical detector units wherein the presence
of a matching second information code is indicated by a zero voltage output from the
12 detector units.

56. The optical code detector of claim 53 further comprising a second code
2 detector array coupled to the optical fiber which detects the information code;
a router coupled to the optical fiber;

4 wherein the second code detector array and the router is coupled to the processor,
wherein the first information code is a start code which is detected by the processor and
6 which sends a command signal to the router to route the signal.

57. A method for decoding information code in an optical data transmission
2 system having a light modulated data signal having a data portion and a header
containing the information code, the method comprising the steps of:
4 carrying the light signal on a fiber optic cable;
separating the information code in the header into discrete light segments;
6 comparing the discrete light segments to a predetermined pattern; and
indicating a match when the predetermined pattern is the same as the discrete
8 light segment.

58. The method of claim 57 further comprising the step of storing the light
segment for a sufficient period of time to compare all the possible iterations of the
predetermined pattern.

59. The method of claim 57 further comprising the step of amplifying the
2 discrete light segment to a sufficient level to provide illumination sufficient to compare
all the possible iterations of the predetermined pattern.

60. The method of claim 57 wherein the discrete light segment represents a bit
2 having a one or zero value.

61. The method of claim 60 wherein the information code further includes a
2 series of one and zero bits, the one bits being coded by amplifying the light signal and the
zero bits being coded by maintaining the light signal at a low level.

62. The method of claim 57 further comprising the steps of:
2 determining whether a predetermined pattern matches the information code; and
routing the light signal according to the information code on a second optic fiber.

63. The method of claim 57 further comprising the steps of:
2 providing a second information code in the header portion;
separating the second information code into discrete light segments;
4 comparing the discrete light segments to a second predetermined pattern; and
indicating a match when the predetermined pattern is the same as the discrete
6 light segment.

64. The method of claim 57 wherein the step of comparing further includes:
2 exposing the light segment to a first photo detector having an anode and a
cathode;

4 providing a second photo detector having an anode, a cathode, the anode of the
second photo detector being coupled to the cathode of the first photo detector, and
6 cathode of the second photo detector being coupled to the anode of the first photo
detector;

8 wherein the step of generating a predetermined pattern includes emitting a light
level representative of a desired code, and exposing the light level to the second photo
10 detector;

determining if there is a zero output from the first and second photo detector
12 indicating a match.

65. An optical buffer for storing data signals from an optical fiber for further
2 downstream processing, the optical fiber carrying data signals at different light
wavelengths and a marker wavelength signal multiplexed as a single signal, and a data
4 sequence encoded on the different light wavelengths by modifying selected data signals,
the optical buffer comprising:

6 an optical data detector optically coupled to the optical fiber, the optical data
detector having detector units which optically sense the data sequence, the detector
8 producing an output indicative of the presence of a selected data sequence code;
a fiber optic output;

10 an optical switch having an input coupled to the optical fiber and a first output
coupled to the fiber optic output, and a second output the optical switch permitting the

12 optical signal to be routed via the first output to the fiber optic output or to the second
output;

14 a buffer fiber optical loop coupled to the detector, wherein the second output of
the optical switch is coupled to the fiber optical loop through the second output; and

16 a processor unit coupled to the detector and the optical switch, wherein the
processor unit reads the output of the detector and controls the optical switch to divert the
18 optical signal to the buffer fiber loop.

66. The optical buffer of claim 65 further comprising:

2 a demultiplexer coupled to fiber optic cable and the optical switch, the
demultiplexer separating the optical signal into different signals at different wavelengths,
4 wherein the optical switch is coupled to one of the different signals; and
a multiplexer coupled to the output of the optical switch..

67. The optical buffer of claim 66 further comprising:

2 a second multiplexer coupled to the second output of the switch, the multiplexer
having an output of a single signal with different signals at different wavelengths;
4 a second demultiplexer coupled to the output of the multiplexer, the
demultiplexer having an output of different signals modulated at different wavelengths.

68. The optical buffer of claim 67 further comprising:

2 an optical code detector coupled to one of the signals modulated at a wavelength
output from the second demultiplexer, wherein the signal has a header portion containing
4 an information code encoded with different levels of light and a data portion, the optical
code decoder including:

6 a plurality of optical storage devices coupled to the optical fiber, each of which
stores a segment of the information code and emitting the light encoding the segment;

8 an optical detector unit for each segment of the information code, each of the
optical detector units being exposed to the segment light and each having:

10 a first photo detector having an anode and a cathode;

 a second photo detector having an anode, a cathode, the anode of the first
12 photo detector being coupled to the cathode of the first photo detector, and the
cathode of the first photo detector being coupled to the anode of the second photo
14 detector;

 a light emitter array optically coupled to the optical detector units a data input channel
16 providing digital data as a new light signal.

69. The optical buffer of claim 68 wherein the first photo detector is coupled
2 to a first reverse bias element and the second photo detector is coupled to a second
reverse bias element.

70. The optical buffer of claim 68 further comprising:

2 a second optical switch for each different wavelength signal having an input
coupled to the output of the second demultiplexer, a first output and a second output;
4 a third multiplexer coupled to the first output of the optical switch;
 a delay fiber optic loop having a first end coupled to the second output of the
6 optical switch and a second end coupled to the first multiplexer.

71. The optical buffer of claim 68 further comprising an optical amplifier
2 having an input coupled to the second output of the second optical switch and an output
coupled to the first end of the delay fiber optic loop.

72. The optical buffer of claim 71 wherein the optical amplifier is an erbium
2 doped optical amplifier.

73. The optical buffer of claim 71 wherein the optical amplifier is coupled to
2 the processor and reshapes and reconditions the signal to add part of a new data
sequence.

74. The optical buffer of claim 71 further comprising:
2 a third optical switch having an input coupled to the second output of the second
optical switch, and a first output coupled to the input of the amplifier and a second output

4 coupled to the first end of the delay fiber optics loop, and the switch is coupled to the
processor;

6 wherein the signal is diverted to the delay fiber optics loop by the processor when
the signal is not amplified.

75. The optical buffer of claim 71 wherein the optical amplifier is coupled to
2 the processor and reshapes and reconditions the signal to add part of a new data
sequence.

76. The optical buffer of claim 70 further comprising:
2 a wavelength converter having an input coupled to the output of the code detector
and an output optically coupled to the second demultiplexer, the converter modulating
4 the signal at a reserved wavelength;
a delay loop coupled to the output of the second demultiplexer at the reserved
6 wavelength; and
a second wavelength converter having an input coupled to the delay loop, and an
8 output coupled to the first end of the fiber optic delay loop.

77. The optical buffer of claim 70 wherein the second optical switch is an
2 optical amplifier coupled to the processor which reshapes and reconditions the signal to
add part of a new data sequence.